

## **Full Length Research**

# **CURRENT NUTRIENT RESOURCE CHARACTERIZATION AND THE LIMITATIONS OF PASTORAL CATTLE PRODUCERS IN NIGERIA**

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The objective of the study was to determine the current feed resources characterization and constraints faced by pastoral cattle producers in the guinea savannah zone of North-Eastern Nigeria. Seasonal feed resources characterization and constraints faced by the cattle producers were determined by questionnaires, direct field observation and interviewing of the cattle producers on herd basis. The study revealed that, during late rainy season (July to September) and early dry season (October to December), 70.00 - 90.00% of farmers depended on natural grasses as sources of nutrients to their cattle. While during the late dry (January to March) and early rainy (April to June) seasons, about 60.00 to 85.00% of cattle herds rely more on crop residues, by-products and browses to supply the nutrient needs of their animals. The study showed that, 21 forage grasses were grazed by cattle during the wet periods across the three study locations. Thus, some of the forages apart from being used as livestock feeds are also consumed by humans as food and medicine. Other uses of forages by indigenous livestock producers include construction of shelters, tents, roofing, beddings, mats and fuel. The study showed that, 19 common forage legumes are grazed by cattle during the wet periods, with little differences in plant composition across the three study locations. The results revealed that, 12 crop residues and 7 by-products were commonly eaten by cattle during dry periods as supplements to lean feed resources. The results also showed very few differences between residues and by-products used at the three study locations. The results of this study also revealed 10 common tree browses that serve as dry periods feed resources in the study locations. The study showed that, 70.00 to 90.00% of the cattle producers in the three locations depended solely on natural flowing streams and rivers for the supply of water to their cattle during late rainy (July to September) and early dry (October to December) seasons. It was observed that, during these periods, the streams and rivers still have abundant running waters. However, during the late dry (January to March) and early rainy (April to June) seasons, about 65.00 to 70.00% of cattle herds relied on ponds, dams and wells to meet their water requirements, with few having access to hand pump boreholes and tap water. Chief among the constraints identified by pastoralists was diminishing natural resources characterized by shrinking land due to expansion in arable farming, land excavations for construction, industrialization and mining activities which have resulted in shortage of natural forage lands for livestock grazing. There's also seasonality in feed and water supply which greatly affect performance, market value of cattle products and the economic status of pastoralists in the zone since they constitute a major socio-economic group in Nigeria.

**Keywords:** Feed Resource, Characterization, Constraints, Pastoral, Cattle, Producers, Nigeria.

## INTRODUCTION

The feed resources of pastoralist cattle consist mainly of grasses, legumes, browses, and cereal crop residues which are indigenous to the production zones and have been reported to be of low yield and quality (Shiawoya and Tsado, 2011; Nweze et al., 2012). Good quality forage is available in adequate amounts to support reasonable level of cattle production from early to late rainy seasons (Moutari, 2008). During these periods, abundant cattle populations are found in the North (Resource Inventory and Management - RIM, 1992; Roger, 1999) while at other times, pasture and range plants decline in quantity and quality (Moutari, 2008). During the dry season period, available natural pastures are low in protein, nitrogen, sulphur, vitamins and other nutrients, while fiber is high with dry matter content of more than 30% (Bonsi et al., 1991; Hughes et al., 2011). Considerable quantities of crop residues and agro-industrial by-products are, also, generated every year. However, because of improper management, they are usually lost, wasted or under-utilized.

The pastoralist cattle production system that evolved over the centuries in the North is based on grazing animals on natural communal pastures and complementary use of fodder and crop residues (Muhammad and Ardo, 2010; Nweze et al., 2012). The system has been defined as adaptation to the harsh and variable physical and environmental conditions of marginal range lands with a view to harnessing the otherwise un-utilizable biomass for production of livestock (Niamir, 1991). There is, therefore, a transhumance or seasonal cyclic movement of animals and farming families synchronous to the rain fall regimes that drives biomass availability (Moran, 2006; Okoli and Kalla, 2008). It is, however, constrained by threats of animal diseases; insecurity, conflict and increasing shortages of forage and water resources for livestock (Muhammad and Ardo, 2010).

Pastoralist livestock management is, therefore, becoming increasingly difficult in Northern Nigeria due to lack of access to enough land in the wake of rapid population growth and agricultural expansion which results in competitive demand for land resources (Nori and Davies, 2007). The current land use pattern and natural resource development and

conservation in Nigeria show that, pastoralism is at cross-roads with uncertain future. Livestock development and empowerment of pastoralists is plagued by a number of problems which may include, among many others, diminishing land space for grazing and livestock movement; deterioration of existing range lands with low biomass yields; scarcity of water; poor carrying capacities of available land; concentration of endemic diseases and parasites; low literacy rates and physical isolation of pastoralists; environmental constraints; absence of functional extension services; distorted agricultural development policies as well as an enduring disconnect between government and aspirations of the pastoralists (Okoli and Kalla, 2008; Muhammad and Ardo, 2010).

To the South of this pastoralist zone is the guinea savannah zone that has more abundant rain fall, biomass resources and permanent water sources. However, this and the rest of the rain forest zones further South are notoriously infested with tsetse fly, the vector of trypanosomiasis and other humidity related diseases and have therefore prevented the sustenance of pastoralist cattle production for ages (Ikede and Taiwo, 1985; Anosike et al., 2003). These Southern zones are home to major crop production activities in the country. Recent prolonged droughts, resulting in shortage of forage and water resources in the arid North, more efficient control of tsetse fly down south, the wide spread availability of veterinary medicines and the increasing use of crossbred cattle have led to increased migration of the pastoralists and their animals into the guinea savannah and the forest zones of Nigeria (Bassett and Turner, 2006).

In addition, changes in the political economy of regional livestock markets and ownership have contributed to movements of pastoralists to the South even though they are faced with conflicts of various degrees with indigenous crop producers (Blench, 2010; Nyong, 2010). Thus, the humid tropical rain forest zone of Southern Nigeria has become a haven for some pastoralists and their livestock (Blench, 1994; Okoli et al., 2012). Frequent conflicts with crop farmers threatens pastoral access to shared material resources, thus, impacting on the sustainability of pastoralism in the forest zones (Tonah, 2006; Ofuoku and Isife, 2009; Okoli et al., 2012). Current approaches of preventing these conflicts show that, controlling reproduction of animals within the carrying capacity of available land is critical (Okoli et al., 2012). The objective of the study was to determine the current feed resource



**Figure 1.** Map of Nigeria showing Adamawa state, the study area in blue.

characterization and constraints faced by pastoral cattle producers in the guinea savannah zone of North-Eastern Nigeria.

## MATERIALS AND METHODS

### The Study Area

Adamawa State is located at the area where the River Benue enters Nigeria from Cameroon Republic and is one of the six states in the North-East geopolitical zone of Nigeria. It lies between latitudes  $7^{\circ}$  and  $11^{\circ}$  North of the Equator and between longitudes  $11^{\circ}$  and  $14^{\circ}$  East of the Greenwich Meridian (Mohammed, 1999). It shares an international boundary with the Republic of Cameroon to the East and interstate boundaries with Borno to the North, Gombe to the North-West and Taraba to the West and South (Adebayo, 1999; Adamawa State Ministry of Land and Survey - ASMLS, 2010a; ASMLS, 2010b), as can be seen in Figure 1.

According to Adebayo and Tukur (1997), Adamawa State covers a land mass of about 38,741km<sup>2</sup>. The state is divided into 21 State Local

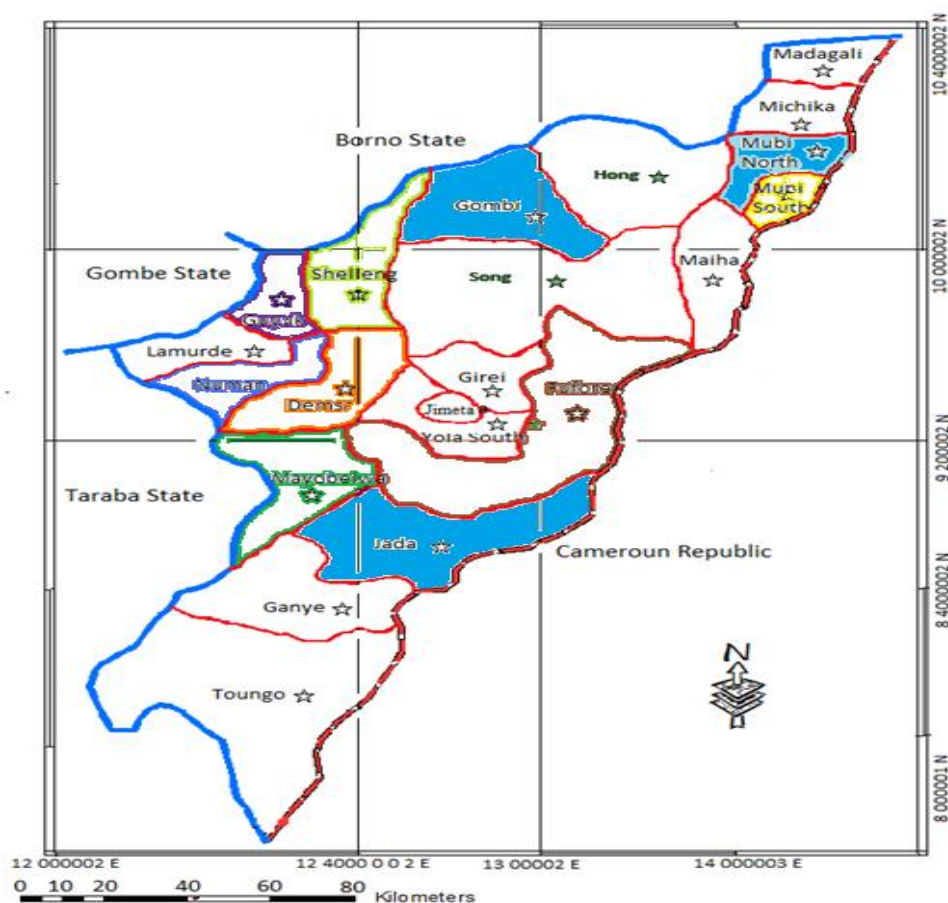
Government Areas with three Senatorial Zones (Northern, Central and Southern) which translated to agricultural zones as defined by Independent National Electoral Commission (INEC, 1996). The State has a population of 2,102,053 people. The main ethnic groups in the state are the Fulani, Quadoquado, Lala, Bwatiye, Chamba, Higgi, Mbula, Margi, Kilba, Ga'anda, Longuda, Kanakuru, Bille, Bura, Yandang, Yungur, Fali, Gude, Verre and Libo (Adebayo and Tukur, 1997; Adebayo, 1999). The dominant religions are Islam and Christianity, although some of its inhabitants still practice traditional African religions. The major occupation of Adamawa people is farming.

The soil type is ferruginous tropical soils of Nigeria based on generic classification of soils by the Food and Agricultural Organization of the United Nations (FAO, 1996). The soils are a function of the underlying rock, the seasonality of rainfall and the nature of the wood-land vegetation of the zone. The soils are derived from the basement complex, granite and gneiss that form the ranges of Mountains. The mineral resources found in the state include iron, lead, zinc and limestone (Adebayo and Tukur, 1997).

The common relief features in the State are the Rivers Benue, Gongola, Yadzaram and Kiri Dam, Adamawa and Mandara mountains and Koma hills. The state has minimum and maximum rainfall of 750 and 1050 mm and an average minimum and maximum temperature of  $15^{\circ}\text{C}$  and  $32^{\circ}\text{C}$ , respectively. The relative humidity ranges between 20% and 30% with four distinct seasons that include: early dry season (EDS, October – December); late dry season (LDS, January – March); early rainy season, (ERS, April – June) and late rainy season (LRS, July – September) (Adebayo, 1999).

The vegetation type is best referred to as guinea savannah (Areola, 1983; Adebayo and Tukur, 1997). The vegetation is made up of grasses, aquatic weeds along river valleys and dry land weeds inter-spaced by shrubs and woody plants. Plant heights ranges from few centimeters (Short grasses) to about one meter tall (tall grasses), which form the bulk of animal feeds.

Cash crops grown in the state include cotton and groundnuts, sugar cane, cowpea, benni seed, bambara groundnut, tiger nut, while food crops include maize, yam, cassava, sweet potatoes, guinea corn, millet and rice. The village communities living on the banks of rivers engage in fishing, while



**Figure 2.** Map of Adamawa state showing the three study LGAs in blue.

the Fulani and other tribes who are not resident close to rivers are pastoralists who rear livestock such as cattle, sheep, goats, donkeys, camels, horses and poultry for subsistence (Adebayo and Tukur, 1997; Adebayo, 1999).

### Study Sites

Three Local Government Areas, one from each of the three senatorial districts in the state were chosen for the study. The Local Government Areas were purposively selected to cut across the state which represents the pastoral zones with higher number of cattle producers in the state (Adebayo, 1999). The study areas include Mubi North (Northern Senatorial Zone), Gombi (Central Senatorial Zone) and Jada (Southern Senatorial Zone) as shown in Figure 2. Ten communities/pastoral camps were randomly selected in each of the study area and one hundred

(100) livestock farms were visited in each study area for interviews, direct observation and data collection across early rainy season (ERS), late rainy season (LRS), early dry season (EDS) and late dry season (LDS), respectively.

Mubi North Local Government Area is located in the Northern part of old Sardauna Province which now forms Adamawa North Senatorial district as defined by INEC (1996). The region lies between Latitudes  $9^{\circ} 30''$  and  $11^{\circ}$  North of the Equator and Longitudes  $13^{\circ}$  and  $13^{\circ} 45''$  East of Greenwich Meridian. Mubi region is bound in the North by Borno State, in the West by Hong and Song LGAs and in the South and East by the Republic of Cameroon. It has a land area of about 4,728.77 km<sup>2</sup> and human population of about 759,045 going by (1991) census projected figure (Adebayo and Tukur, 1991).

Gombi Local Government Area is one of the oldest Local Government Areas in Adamawa State



strategically positioned North of the River Benue in the State. The region lies between Latitudes  $10^{\circ} 09'$  and  $10^{\circ} 40'$  North and Longitudes  $12^{\circ} 44'$  and  $13^{\circ} 23'$  East. It is bordered in the East by Hong Local Government Area, West by Shelleng Local Government Area, South by Song Local Government Area and South-East by Biu Local Government Area of Borno State. It has high number of cattle producers and a good cattle market every Friday (Adebayo and Tukur, 1991).

Jada Local Government Area is one of the Local Government Areas in the Southern Senatorial Zone of Adamawa State. It is located at an elevation of 360 meters above sea level and has population of 250,459 people. Its coordinates are  $8^{\circ} 46'$  North and  $12^{\circ} 9'$  East. It is bordered in the North - East by Yola south Local Government Area, South-East by Ganye Local Government Area, West by Mayo Belwa Local Government Area and South by Zing Local Government Area in Taraba State (Adebayo and Tukur, 1991).

### **Data Collection**

The data collection instruments used include, short questionnaires, oral interviews and field observations. Well structured questionnaires were developed in English language and distributed and where a farmer does not understand English, Hausa and Fulfulde languages were used.

**Feed Resource Characterization:** Seasonal feed and water resources characterizations were determined by questionnaires, direct field observation and interviewing of the cattle producers on herd basis. The identification of forages was done using botanical, English and Hausa names for ranking, aggregates and frequency of occurrences of plants in each study area.

Forage resources, legumes and browses common during wet period (May - Sept.) were, also, determined by questionnaires, interview, kraal visits and direct field observation for at least two hours in the morning during grazing.

Crop residues, by-products and browse resources available during dry period (October - April) were also determined by questionnaires, interview, kraal visits and direct field observation for at least two hours in the morning during grazing.

Methods adopted to solve problem of lean feed resources during critical periods of the year were also determined through informal survey and

discussion with the farmers.

### **Constraints to Cattle Production**

Major constraints faced by cattle producers such as feed supply and quality, parasites infestation, disease incidences, pastoral land situation, lack of government support, loans and incentives, grazing reserves, grazing routes, range lands, markets and lack of improve breeds. Also, problem of conflicts with arable crop producers, security situation, functions of middle men, environmental conditions were, also, determined by questionnaires, direct field observation and interviewing the cattle producers on herd basis.

### **DATA ANALYSIS**

All survey data generated were subjected to descriptive statistics such as frequencies and percentages.

## **RESULTS AND DISCUSSION**

### **Seasonal Cattle Feed Resources Characteristic in Adamawa State, Nigeria**

#### **(a) Seasonal forage resources availability in Adamawa State**

The results of seasonal feed resources availability in all the study locations are presented in Table 1. The study revealed that, 90.00% of the farmers at the three locations depended on natural pastures and range lands for feeding their cattle during late rainy season (July to September) as against 10.00% dependence on crop residues, by-products and browses. During early dry season (October to December), 70.00 - 80.00% of farmers depended on natural grasses against 20.00 - 30.00% dependence on other sources. It was observed that, there are abundant forages and browses in the pasture and range lands during these seasons which gradually mature, as the seasons progress. During these periods, the Fulani herdsman make excellent use of sign language, the cane and verbal command to drive the animals, with the faster, stronger and more active animals occupying the front rows.

During the late dry (January to March) and early rainy (April to June) seasons, about 60.00 to

**Table 1.** Seasonal Feed Resource Characterization in Adamawa State.

<b>Parameters</b>	<b>Mubi North</b>		<b>Gombi</b>		<b>Jada</b>	
<b>Feed Resources</b>	<b>Freq.</b>	<b>%</b>	<b>Freq.</b>	<b>%</b>	<b>Freq.</b>	<b>%</b>
<b>LRS(July-Spt.)</b>						
Pasture and Range lands	90	90	90	90	90	90
C/ Residues/ By - products/ Browsers	10	10	10	10	10	10
Concentrates	-	-	-	-	-	-
<b>EDS(Oct-Dec.)</b>						
Pasture and Range lands	80	80	70	70	70	70
C/ Residues/ By - products/ Browsers	20	20	30	30	30	30
Concentrates	-	-	-	-	-	-
<b>LDS(Jan-Mar)</b>						
Pasture and Range lands	15	15	20	20	40	40
C/Residues/ By - products/ Browsers	85	85	80	80	60	60
Concentrates	-	-	-	-	-	-
<b>ERS(Apr-Jun)</b>						
Pasture and Range lands	10	10	15	15	10	10
C/Residues/ By - products/ Browsers	80	80	85	85	80	80
Concentrates	10	10	-	-	10	10

Late rainy season (**LRS**), Early dry season (**EDS**), Late dry season (**LDS**), Early rainy season (**ERS**).

85.00% of cattle herds rely more on crop residues, by-products and browses to supply the nutrient needs of their animals. This is because, the annual forages have been grazed to defunct and where standing hay are common, the forages have lost their nutrient contents and bush fire may have consumed major grazing areas. It was also observed that, during these periods, crop farmers have finished harvesting their crops, the residues and by-products are, therefore, sold or given free of charge to cattle producers to graze their animals on. Movement and splitting of herds are, also, common methods adopted to solve the problem of lean feed resources during these critical periods of the year. However, scientific forage conservation is not a common practice amongst the cattle producers.

The results also showed that, concentrates were not offered to cattle during the feed resource abundant seasons and only few pastoralists (10.00%), however, offered concentrate and salt lick to their cattle to supplement for nutrients and minerals obtained from forages during the early

rainy season periods. This could be attributed to the fact that, concentrates and salt licks are always expensive. These results also corroborate that of Okoli et al., (2012), who reported pastoralist cattle production to be based on grazing natural pastures synchronous to the rain fall regimes that drive biomass availability in South-Eastern Nigeria. Nweze et al., (2012), reported similar findings that animals virtually depend on the naturally available pastures for nutrients supply and that, feed resources of pastoralist cattle consists mainly of grasses, legumes, browses and cereal crop residues indigenous to the production zones.

However, Ogunbosoye and Babayemi (2010) reported that, tropical grass fodder and crop by-products available during dry season have low nutritive values due to their low protein and fermentable energy. These plants grow rapidly during the period of heavy rainfall and high temperature and this leads to grass maturing early and so contains high level of lignin. The nutritive value of pastures fall rapidly with maturity and,

during the dry season, the available feed is lignified. It is, therefore, the search for better feed resources that drive the herding cycle of the Fulani. Describing the annual herding cycle of the Fulani during these periods, Fricke (1979), Vengroff (1980) and Iro (1994) stated that, the herding season begins with southward movement of the herds and along rivers and stream valleys from October to December, marking the end of rainy season and beginning of dry season. January to February is the harmattan season, characterized by longer grazing hours, herd splitting, and more frequent visits to stable water sources and marks increase in the southward movement of the herds. March and April are usually the toughest for the herdsman and their cattle, as they are the hottest periods in the grazing calendar, making cattle herding possible only in the evenings and nights (Riesman, 1977). May and June signify the end of dry season and vegetation begins to appear. This also marks the beginning of northward movement of cattle herds. This period up till September, the peak of the rainy season, is characterized by more cattle-breeding, more milk production and shorter grazing hours. According to Iro (1994), herding is a daunting task, with about 75% of sampled pastoralists maintaining that cattle herding is not only toilsome, but also becoming increasingly strenuous and hazardous.

#### **(b) Forage grasses distribution during wet periods in Adamawa State**

The results of the distribution of common forage grasses grazed by cattle during the wet periods in the study areas are shown in Table 2. The study showed that, 21 forage grasses were grazed by cattle during the wet periods across the three study locations.

The ranking of the forage resources was done based on their availability and uses. Those forages that are commonly available with multiple or more than two uses were ranked the most valuable taking the list of 1 - 17, while 18 - 22 with one to two uses only were ranked as the less valuable. Thus, some of the forages apart from being used as livestock feeds are also consumed by humans as food and medicine. Other uses of forages by indigenous livestock producers include construction of shelters, tents, roofing, beddings, mats and fuel. The findings support the report of Peters et al., (2001), who surveyed common forages in Central America and West Africa and their roles in reducing poverty and

degradation of natural resources in tropical production systems. The results, also, agree with Babayemi et al., (2014), who enumerated some of the common grass forage resources in Nigeria. Smith (1992) and Aregheore (2001), surveyed available forage resources in the savannah zones of Nigeria and reported that, forages grow rapidly during the wet season, becoming fibrous and coarse and are under-grazed because of the large amounts that become rapidly available. Their quality however, declines during the dry season when they become standing hay and are subject to overgrazing.

#### **(c) Forage legumes distribution during wet period in Adamawa State**

The results of common forage legumes grazed by cattle during the wet periods in the study areas are shown in Table 3. The study showed that, 19 common forage legumes are grazed by cattle during the wet periods, with little differences in plant composition across the three study locations. Plant identified appeared at the three locations except *Stylosanthes guinensis*, *Stylosanthes hamata* and *Stylosanthes humilis*, which were not common to Jada Local Government Area. Also, the ranking of the forage legume resources was done as described under the forage grasses. Those legumes that are commonly available with multiple or more than two uses were ranked the most valuable taking the list of 1 - 10, while 11 - 19 are those with one to two uses only and were ranked as the less valuable. The results agree with that of Devendra (1990) who reported that, leguminous forages and the foliage of multipurpose trees found in Africa are promising sources of protein, if used as a supplement to ruminants receiving low-quality forages. This result expectedly disagrees with the report of Okoli et al., (2003), who reported much more browse resources in tropical humid rain forest of South - Eastern Nigeria than the few highlighted here but agree with Babayemi et al., (2014), who listed some of the common legume resources found in West Africa and Nigeria.

#### **(d) Crop residue and by-products distribution during dry periods in Adamawa State**

Data in Table 4 revealed that, 12 crop residues and 7 by - products were commonly eaten by cattle during dry periods as supplements to lean feed

**Table 2.** Commonly Grazed Forage Grasses during Wet Period.

S/No.	Botanical Name	English Name	Hausa Name	Mubi North	Gombi	Jada	Freq
1	<i>Panicum purpureum</i>	Elephant grass	CiyawanZana	+	+	+	3
2	<i>Panicum maximum</i>	Guinea grass	CiyawanTufaniya	+	+	+	3
3	<i>Andropogon gayanus</i>	Northern gamba	CiyawanJinka	+	+	+	3
4	<i>Cynodon plectostachyus</i>	Giant star grass		+	+	+	3
5	<i>Chloris gayana</i>	Rhodes grass		+	+	+	3
6	<i>Brachiaria decumbens</i>	Signal grass		+	+	+	3
7	<i>Digitaria decumbens</i>	Pangola grass		+	+	+	3
8	<i>Hyparrhenia rufa</i>	Thatch grass		+	+	+	3
9	<i>Imperata cylindrica</i>	Spear grass		+	+	+	3
10	<i>Cenchrus ciliaris</i>	Buffel grass		+	+	+	3
11	<i>Cynodondactylon</i>	Bahama grass		+	+	+	3
12	<i>Sorghum spp</i>	Gunea corn	Dawa	+	+	+	3
13	<i>Sorghum bicolar</i>	Sorghum	Jigari	+	+	+	3
14	<i>Pennisetum americanum</i>	Millet	Maiwa	+	+	+	3
15	<i>Zea mays</i>	Maize	Masara	+	+	+	3
16	<i>Saccharum officinarum</i>	Sugar cane	Rakke	+	+	+	3
17	<i>Oryza sativa</i>	Rice	Shinkafa	+	+	+	3
18	<i>Axonopus compressus</i>	Carpet grass	Kirikiri	+	+	+	3
19	<i>Tripsacum laxum</i>	Guatemala grass		+	+	+	3
20	<i>Digitaria smutsii</i>	Wooly finger grass		+	+	+	3
21	<i>Setaria anceps</i>	Setaria grass		+	+	+	3
22	<i>Elusine indica</i>	Stubborn grass		+	+	+	3
<b>Total</b>				<b>22</b>	<b>22</b>	<b>22</b>	<b>66</b>

resources. The results also showed very few differences between residues and by-products used at the three study locations. Every dry season, feed resources identified appeared in all the three locations except some agro - industrial wastes such as sugarcane straw, molasses and cotton seed cake, which were common only in Jada Local

Government Area. This could be because of the location of Savannah Sugar Company of Nigeria, Numan and African Cotton Company, Ngurore which are in the Southern Senatorial Zone. Crop farmers within the localities and the surrounding Local Government Areas engage in commercial production of sugar cane and cotton to supply

raw materials for the industries. The uniformity of geographic and ecological zone (guinea savannah), which is characterized by short duration of rainy seasons, low humidity and high sun intensity favour cereal crop production in the study area. Grain residues were ranked low by the farmers even though they are commonly abundant and cheap to



**Table 3.** Commonly Grazed Forage Legumes during Wet Period.

S/No.	Botanical Name	English Name	Hausa Name	Mubi North	Gombi	Jada	Freq.
1	<i>Stylosanthes guinensis</i>	Cook stylo		+	+	-	2
2	<i>Stylosanthes hamata</i>	Veranostylo		+	+	-	2
3	<i>Pueraria phaseoloides</i>	Common puero		+	+	+	3
4	<i>Lablab purpureus</i>	Lablab bean	Waken daji	+	+	+	3
5	<i>Glycine max</i>	Soya bean	Waken Soya	+	+	+	3
6	<i>Arachis hypogaea</i>	Ground nut	Gyada	+	+	+	3
7	<i>Vigna unguiculata</i>	Cowpea	Wake	+	+	+	3
8	<i>Cajanus cajan</i>	Pigeon pea	Gweanbiri	+	+	+	3
9	<i>Centrosema pubescens</i>	Common centro		+	+	+	3
10	<i>Stylosanthes humilis</i>	Townsville stylo		+	+	-	2
11	<i>Desmodium corpiurus</i>	Samoan clover		+	+	+	3
12	<i>Desmodium intortum</i>	Green leaf		+	+	+	3
13	<i>Gliricidia sepium</i>	Almond blossom		+	+	+	3
14	<i>Macroptiliumatro purpureum</i>	Siratro		+	+	+	3
15	<i>Neonotonia wightii</i>	Glycine		+	+	+	3
16	<i>Mucuna utilis</i>	Mucuna		+	+	+	3
17	<i>Stylosanthes gracilis</i>	Schofield stylo		+	+	+	3
18	<i>Macrotylo maaxillare</i>	Axillaris		+	+	+	3
19	<i>Centrosema molle</i>	Centro		+	+	+	3
<b>Total</b>				<b>19</b>	<b>19</b>	<b>16</b>	<b>54</b>

obtain but are not properly handled and poorly utilized by the animals, while by-products though scarce were ranked highest in the study areas because of the animals' ability to utilize them better. The findings also supported that of Adegbola (1985) and Alhassan et al., (1987) who reported that, cheap feed resources in Nigeria include crop residues, agro-industrial by-products, animal processing wastes, brewery waste and by-products, farm animal wastes such as poultry

litters, animal faeces and other forms of fiber, protein and energy by-products suitable for ruminant feeding as well as browse plants. In another study, Adegbola (1998) reported that, these availability of crop residues are characterized by high content of fiber usually above 40%, low content of nitrogen (0.3-1.0%) and low content of essential minerals such as Sodium (Na), phosphorous (P) and calcium (Ca).

Almost all crops cultivated for human

consumption contain residual materials which can be consumed and converted to valuable products by livestock. Estimates in Africa alone show that, more than 340 million tonnes of fibrous crop residues are produced annually (Kossila, 1984). Lufadeju, (1990) also, estimated that over 111.5 million tonnes of crop residues are produced in Nigeria each year. These consist of 24.6 million tonnes of millet, 17.2 million tonnes of guinea corn, 2.5 million tonnes of maize, 0.2 million tonnes of

**Table 4.** Commonly Fed Crop Residues and By-Products during Dry Period.

S/No.	English Name	Hausa Name	Mubi North	Gombi	Jada	Freq.
<b>Crop residues</b>						
1	Maize Stover	Karan Masara	+	+	+	3
2	Sorghum Stover	Karan Jigari/ Dawa	+	+	+	3
3	Sorghum Shafts	Kaikaiyin Jigari/Dawa	+	+	+	3
4	Millet Stover	Karan Maiwa	+	+	+	3
5	Yam Peels	Bawon Doya	+	+	+	3
6	Cassava Peels	Bawon Rogo	+	+	+	3
7	Sweet Potato Peels	Bawon Dankali	+	+	+	3
8	Rice Straws	Harawan Shinkafa	+	+	+	3
9	Groundnut Straws	Harawan Gyada	+	+	+	3
10	Cowpea Husk	Kaikaiyin Wake	+	+	+	3
11	Cowpea Straw	Harawan Wake	+	+	+	3
12	Sugarcane Straws	Harawan Rake	-	-	+	1
<b>By-products</b>						
1	Sorghum Bran	Dusan Jigari/Dawa	+	+	+	3
2	Maize Bran	Dusan Masara	+	+	+	3
3	Millet Bran	Dusan Maiwa	+	+	+	3
4	Rice Bran	Dusan Shinkafa	+	+	+	3
5	Brewers Waste	Dusan Giya	+	+	+	3
6	Molasses	Ruwan Rake	-	-	+	1
7	Cotton Seed Cake	Dusan Auduga	-	-	+	1
<b>Total</b>			<b>16</b>	<b>16</b>	<b>19</b>	<b>51</b>

rice, 1.3 million tonnes of groundnut and 3.7 million tonnes of cowpea residues at the major production areas of Sokoto, Kano, Bauchi, Adamawa, Kaduna, Benue, Borno and Anambra States of Nigeria (Alhassan, 1985).

It was observed in this study that, most of the crop residues are abundant during the months of October to December (early dry season), while they are mostly needed and utilized between March and July (late dry and early rainy seasons), when the available pasture is low in quantity and quality. These abundant crop residues can supply enough roughage for the ruminant population in the country if properly harnessed, processed and preserved. When crop residues are fed to ruminants, their intake is low and their utilization is limited by the slow rate of total degradability and the rate at which particles are broken down to a critical size small enough to leave the rumen. There is therefore, the need for their further processing, especially grinding to smaller particle sizes.

#### **(e) Browsed tree resources distribution during dry season in Adamawa State**

The results of this study revealed 10 common tree browses that serve as dry periods feed resources in the study locations (Table 5). The results support the report of Okoli et al., (2003) that, there is an abundance of tropical browse plants available to ruminants in Nigeria. Earlier reports by Olayemiet al., (1998) and Omokaye et al., (2001) have also highlighted the available browse resources in Nigeria, while Opara, (1996) and Oji and Isilebo, (2000) reported that, such browse plants provide the vitamins and mineral elements, which are frequently lacking in grassland pastures. Their year round evergreen presentation and nutritional abundance provides for year round provision of fodder. The diversity and distribution of browse plants of Northern Nigeria have also received attention in studies carried out in the North (Saleem et al., 1979) and Middle Belt (Ibeawuchi et al., 2002) of Nigeria.

Odoh and Adamu-Noma, (2000) stated that, browse enable standing feed reserve to be built so that herds can survive critical periods of shortfall, or even prolonged periods of drought, without remarkable weight losses.

In recent time however, deforestation, urbanization and bush burning have become major factors responsible for dwindling proceeds of browse feed resources for ruminant livestock, especially in Northern Nigeria. For example, according to Yahya et al., (2000), traditional herdsman and other pastoral groups habitually cut down branches from various trees species such as *Acacia*, *Adamasonia* and *Ficus spp.*, making them available to livestock during the dry season, when no other forage is available. Browse plants, beside grasses, constitute one of the cheapest sources of feed for ruminants.

Many browse species have chemicals that appear to be produced for the purpose of deterring invasion or consumption of their leaves by microbes, insects and herbivorous animals (Njidda, 2010). However, Gidado et al., (2013), in their study of anti-nutritive factors and nutrient composition of some selected browse plants used as livestock feeds in neighboring Taraba State, reported that, the effects of high protein forage could over-ride the effect of the toxic compounds when used as supplement in the diets.

#### **(f) Seasonal livestock water resources characteristics in Adamawa State**

Table 6 showed that, 70.00 to 90.00% of the cattle producers in the three locations depended solely on natural flowing streams and rivers for the supply of water to their cattle during late rainy (July to September) and early dry (October to December) seasons. It was observed that, during these periods, the streams and rivers still have abundant running waters. However, during the late dry (January to March) and early rainy (April to June) seasons, about 65.00 to 70.00% of cattle herds relied on ponds, dams and wells to meet their water requirements, with few having access to hand pump boreholes and tap water. This is because streams and rivers dry out shortly after the rains have stopped, since the duration of rainy season ranges from 3 to 4 months in the study area. Again, it was observed that, the farmers did not make any effort to trap and preserve rain water for their cattle and other domestic uses. Building and construction of

ponds, dams and wells are capital intensive projects for the cattle producers who mostly keep livestock for subsistence. The cost of drilling boreholes and fixing tap water is also beyond the reach of common livestock producers.

These results agree with Kubkomawa et al., (2011), who reported that, shortages and scarcity of potable water supply in Yang ward of Lala District, Gombi Local Government Area of Adamawa State is endemic and affects the people and their livestock, especially during the dry season. They also investigated alternatives to ground water sources and recommended rainwater harvesting as a viable alternative for solving the problem of water supply shortages for domestic and agricultural purposes in the area.

#### **(g) Constraints to cattle production in Adamawa State, Nigeria**

The results of constraints to cattle production in Adamawa State are presented in Table 7. Chief among the constraints identified by pastoralists was diminishing natural resources characterized by shrinking land due to expansion in arable farming, land excavations for construction, industrialization and mining activities (43.33%), which have resulted in shortage of natural forage lands for livestock grazing. There's also seasonality in feed and water supply with Mubi North and Jada having 45.00% each followed by Gombi with 40.00%. These results corroborate that of Shiawoya and Tsado (2011), who reported similar findings in line with other reports by Hesse and MacGregor (2006), Okoli and Kalla (2008) that, shrinking pastoral land with the opportunities for pastoral people to make a viable living has put the industry in a serious crisis. Indeed, political and economic factors are combining to replace pastoral grazing land with other allegedly more beneficial land uses (Hesse and MacGregor, 2006). Eroding feeding resource has, also, been linked by farmers to changes in economy, inappropriate aid, conversion of range lands and mixed farming systems for crop production and game parks.

Second to diminishing nutritional resources, were environmental and health constraints characterized by desertification, climate change, insecurity, conflicts and diseases that received a score of 33.33% from the cattle producers (Table 7). Across the three study locations, these problems were scored 35.00% at Mubi North and Gombi LGAs and

**Table 5.** Commonly Browsed Tree Resources during Dry Period.

S/No.	Botanical Name	English Name	Hausa Name	Mubi North	Gombi	Jada	Freq.
1	<i>Acacia spp</i>	Acacia	Madaci	+	+	+	3
2	<i>Leucaena leucocephala</i>	Leucaena		+	+	+	3
3	<i>Moringa oleifera</i>	Moringa	Zoggale	+	+	+	3
4	<i>Balanites aegyptica</i>		Adua	+	+	+	3
5	<i>Khayasene galensis</i>			+	+	+	3
6	<i>Tamarindus indica</i>	Tamarind	Tsamiya	+	+	+	3
7	<i>Terminalia vicenoides</i>			+	+	+	3
8	<i>Mangifera indica</i>	Mango	Mangoro	+	+	+	3
9	<i>Azelia Africana</i>			+	+	+	3
10	<i>Ficus polita</i>			+	+	+	3
<b>Total</b>				<b>10</b>	<b>10</b>	<b>10</b>	<b>30</b>

**Table 6.** Seasonal Water Resources Characterization in Adamawa State.

Parameters	Mubi North		Gombi		Jada	
Water resources	Freq.	%	Freq.	%	Freq.	%
<b>LRS(July-Spt.)</b>						
Streams/Rivers	85	85	90	90	80	80
Ponds/Dams/Wells	10	10	5	5	15	15
Boreholes/Taps	5	5	5	5	5	5
<b>EDS(Oct-Dec.)</b>						
Streams/Rivers	75	75	70	70	75	75
Ponds/Dams/Wells	15	15	15	15	15	15
Boreholes/Taps	10	10	15	15	10	10
<b>LDS(Jan-Mar)</b>						
Streams/Rivers	25	25	20	20	10	10
Ponds/Dams/Wells	65	65	60	60	70	70
Boreholes/Taps	10	10	20	20	20	20
<b>ERS(Apr-Jun)</b>						
Streams/Rivers	15	15	10	10	10	10
Ponds/Dams/Wells	70	70	70	70	70	70
Boreholes/Taps	15	15	20	20	20	20

30.00% at Jada LGA. These conflicts between pastoralists and crop producers, insecurity, wars and other forms of socio-political problems have become more frequent and have led to livestock owners moving their stock out of their usual area, thus, increasing the possibility of mixing with other breeds thereby potentially losing location-specific breeds (Hansen, 1992). These findings also corroborate that of Okoli et al., (2014), who reported that, pastoral communities in Nigeria are

increasingly moving and settling southwards in the humid tropical rain forests in response to changing Sahelian and savannah environments traditionally occupied by them. This creates conflicts with crop farmers in the tropical rainforests and threatens pastoral access to shared natural resources, thus, impacting on the sustainability and future of pastoralism in Nigeria. In addition, natural disasters such as flood, drought, famine, desertification, global warming, and livestock diseases and

**Table 7.** Constraints of Cattle Production.

Parameters	Mubi North		Gombi		Jada		
Major Constraints	Freq.	%	Freq.	%	Freq.	%	%Mean
<b>(a) Nutrition</b>							
Seasonal Feed and Water Shortage, Shrinking Pasture and Range Lands	45	45	40	40	45	45	43.33
<b>(b) Environmental and Health</b>							
Desertification and Climate Change, Conflicts/ Insecurity, Diseases and Parasites	35	35	35	35	30	30	33.33
<b>(c) Government Policy</b>							
Lack of Govt. support, Lack of Good Markets, Activities of Middle Men	20	20	25	25	25	25	23.33
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100.00</b>

parasites have in numerous cases resulted to breeds of cattle dying out (Spore, 2005; Okoli and Kalla, 2008).

It was observed that, lack of good government policies on pastoralism, lack of grazing reserves and grazing routes, lack of financial support from government and financial institutions; lack of good cattle markets and marketing strategies with too many middle men also form part of the problems of cattle production at the study sites. Interestingly, government policy characterized by lack of support, good market and activities of middle men received a lowly overall score of 23.33% as minor constraint to cattle production in the study area. This low score may be linked to the low literacy rate among the pastoralists which may prevent them from appreciating their rights as citizens of Nigeria. These results corroborate that of Mapiye et al., (2009), who stated similar impediments to cattle production and breeding efficiency on grazing rangelands, especially in the dry season. Muhammad and Ardo, (2010) also reported that, cattle production in the guinea savannah of Nigeria is constrained by threats of animal diseases; insecurity, conflict and shortage of forage and water resources for livestock.

Pastoral livestock management is becoming increasingly difficult in Northern Nigeria due to lack of access to enough land in the wake of rapid population growth and agricultural expansion which results in competitive demand for land resources (Nori and Davies, 2007). The current land use pattern and natural resource development and conservation in Nigeria shows that pastoralism is at

cross-roads with uncertain future. Livestock development and empowerment of pastoralists is plagued by a number of problems which, among many others already listed, may include low biomass yields, scarcities of water, poor carrying capacities of available land, concentration of endemic diseases and parasites, low literacy rates and physical isolation of pastoralists, absence of functional extension services, distorted agricultural development policies as well as an enduring disconnect between government and aspirations of the pastoralists (Okoli and Kalla, 2008; Muhammad and Ardo, 2010).

## CONCLUSION AND RECOMMENDATIONS

It was concluded that, the major challenge to pastoralist cattle producers in the dry areas of Northern Nigeria is the changing environment characterized by shrinking land due to expansion in arable farming; land excavations for construction; industrialization and mining activities, which have resulted in shortage of natural forage lands for livestock grazing. The eroding feeding resource is, also, linked to changes in economy, inappropriate aid, conversion of range lands and mixed farming systems for crop production and game parks. In addition, natural disasters such as flood, drought, famine, desertification, global warming, livestock diseases and parasites have in numerous cases resulted to certain breeds of cattle dying out. The traditional pastoralist system in Nigeria is highly vulnerable because of heightened insecurity situations, while resilience and adaptation options

are almost exhausted without any new place to go to because of conflicts with crop producers in the northern guinea savannah and southern rain forest havens. This shrinking pastoral land with consequent shrinking opportunities for pastoral people to make a viable living has put the industry in a serious crisis since pastoralists constitute a major socio-economic group in Nigeria. Some levels of sedentary system and controlled breeding to match the available resources may be the only solution to the current situation. This will also help to boost production and reduce the over dependence on oil as a major source of revenue in the country.

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